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Two southeastern Atlantic records of the rare largetooth cookiecutter shark, *Isistius plutodus* (Selachii, Squaliformes, Dalatiidae)

by

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Résumé. – Deux nouveaux signalements en Atlantique SE du très rare requin pélagique *Isistius plutodus* (Selachii, Squaliformes, Dalatiidae).

Deux nouvelles femelles du très rare requin pélagique *Isistius plutodus* Garrick & Springer, 1964 (Dalatiidae) sont présentées comme étant les premiers signalements de l'espèce sur la dorsale de Walvis dans l'Atlantique SE. Elles sont décrites en détail avec leurs données morphométriques et méristiques, et illustrées par des photographies. Les 10 spécimens décrits à ce jour après l'holotype ont été recherchés dans les collections, et seulement cinq d'entre eux (AMS, MOVI, ZMH, ZUEC) ont été retrouvés. S'ajoutent les deux signalements du SE Atlantique décrits ici et un nouveau signalement au large du Japon.

Keywords. – Dalatiidae – *Isistius plutodus* – SE Atlantic – New records – Rare species.

Since Garrick and Springer (1964) described *Isistius plutodus* from a 423 mm TL female (USNM 188386) taken off the Mississippi Delta over 814-997 m bottom depth, only less than 10 further records have been published from scattered localities within the Atlantic and Pacific Oceans. Parin (1975) reported on the second specimen and first Pacific record found at 200 m depth near Okinawa, Japan (male 335 mm TL); despite search at the collections of the IOAN and ZMMU in Moscow and at ZIN St. Petersburg, Parin's specimen was not found and must be considered lost. Golovan and Pakhorukov (1986) briefly described the third specimen and first eastern Atlantic record (female 270 mm TL) from off NW Africa (22°52'N) at 2010-2060 m depth, but this specimen got lost in Sevastopol according to recent information by S. Tsarin (pers. com., C. Nigmatullin). Sadowsky *et al*. (1988) reported on the fourth specimen from off Brazil (30°30'S; 50°06'W) and first southern hemisphere record (female, 320 mm TL). According to coauthor Amorim (pers. com., F. Petean), this specimen got lost in Santos. Amorim *et al*. (1998) mentioned another four specimens taken by commercial longliners off Brazil but without further details, and these are not yet published and eventually also lost in Santos (pers. com., F. Petean). McGrouther (2001) published the ninth specimen and first record in Australian waters off New South Wales (female 363 mm TL, AMS I.28924-001). Soto and Mincarone (2004) listed in a collection catalogue with only locality details a male of about 310 mm TL (MOVI 19660) as tenth record, interestingly found in the stomach of a *Prionace glauca* caught in February 2002 by longline at about 34°S, 32°W at 30-60 m depth off Brazil. Zidowitz *et al*. (2004) described a 417 mm TL female (ZMH 9368) taken at 90-100 m depth by midwater trawl north of the Azores (43°48'N, 28°32'W) as eleventh record and northernmost one so far. Another NW Pacific specimen was caught in December 2010 (male 332 mm TL, HUMZ 210817) southeast off Japan and will be published soon by K. Suda (pers. com.). Of the 10 specimens published after the holotype since 1975, unfortunately only three appeared to physically still exist in collections, plus the two SE Atlantic records described in the present paper and the new record from off Japan.

However, Flávia Petean (Inst. Biociências Univ. São Paulo) recently informed the first author, that she found two more specimens in the Museu de Zoologia da Universidade Estadual de Campinas - ZUEC Coleção de Peixes (Brazil) – she will investigate soon and describe them in her MSc. Thesis; these are likely two of the five lost specimens from Santos: ZUEC-PIS 8332, female, 329 mm TL, off Rio Grande do Sul coast, Brazil, 30°30'S, 50°06'W, longline, 1300 m depth, 17 Sep. 1987 [probably the female published by Sadowsky *et al*. (1988)]; ZUEC-PIS 8333, male, 333 mm TL, off east coast of Brazil, from Bahia to Rio Grande do Sul, 17°-35°S, 27°-52°W, longline [probably one of the four specimens mentioned by Amorim *et al*. (1998)].

The fish curator at ZUEC, Flavio Lima, confirmed there were no labels with collection numbers or locality data with these specimens, and he had no information on how these specimens got into the ZUEC collection (pers. com., F. Petean).

The few other literature references found to date actually refer only to the holotype (USNM 188386) and subsequent new records, as given above, in context with descriptions of *I. brasiliensis* or regional faunal lists and books, but provide no additional information about new records of *I. plutodus* (e.g. Cadenat and Blache, 1981; Compagno, 1984; Hatooka *et al*., 2013).

The second author of the present study showed the first author the two SE Atlantic specimens during a study visit to AtlantNIRO, Kaliningrad, of which one was taken on loan to Hamburg for detail investigation also by radiographs. These new records are described and illustrated here as the first ones from the SE Atlantic.

MATERIAL AND METHODS

AtlantNIRO 23074, female, 420 mm TL, Fishing vessel 'Zund', 27 Oct. 1988; 32°55'S, 02°24'W; 0-640 m depth. Caught by longline. W.I. Anenko coll.

AtlantNIRO 24000, female, 330 mm TL, RV 'Atlantniro', 10 Nov. 1990; 33°19'S, 02°16'W; 960-1260 m depth. Midwater trawl number 47. I. A. Trunov coll.

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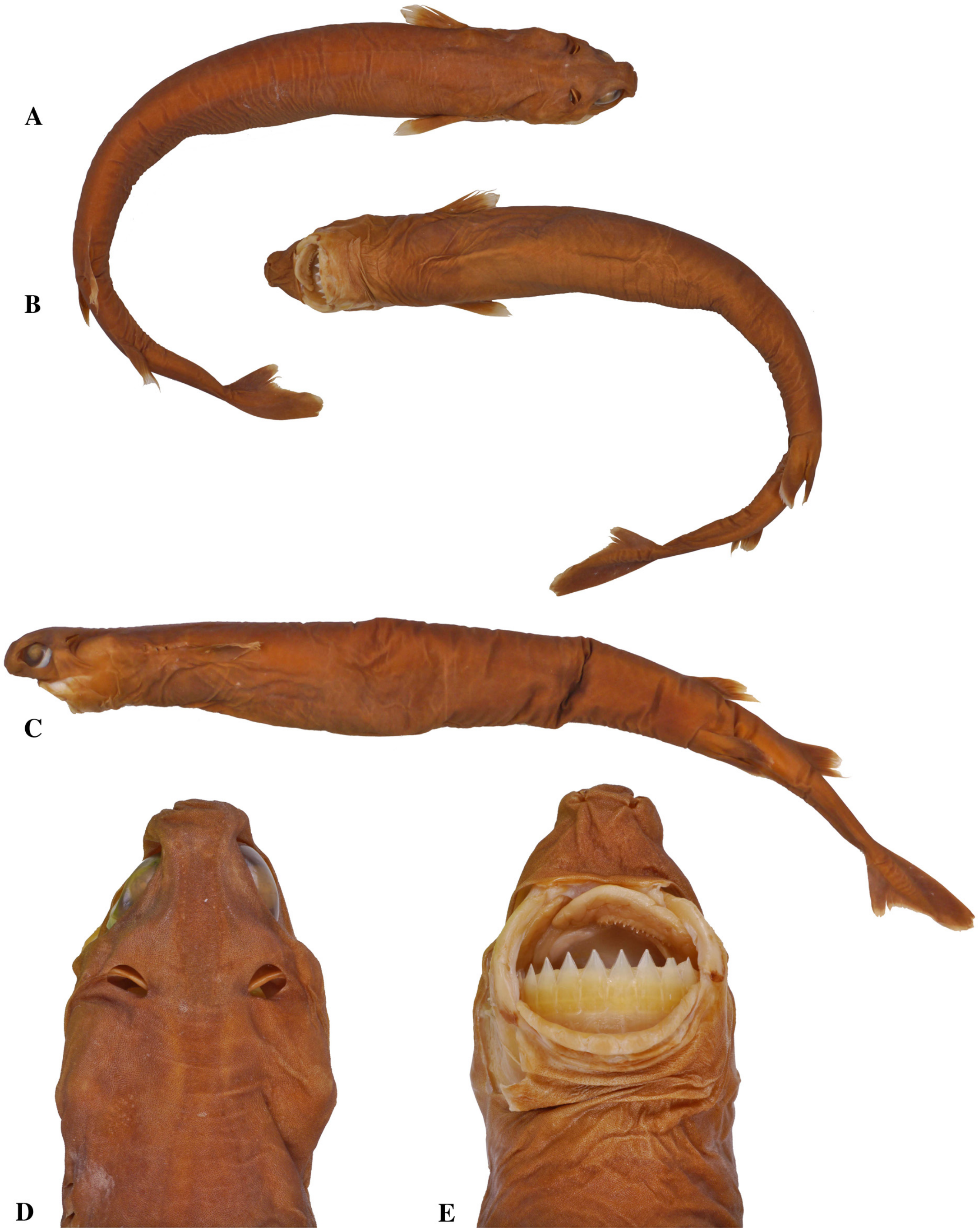

Figure 1. - *Isistius plutodus* female, 420 mm TL, AtlantNIRO 23074. **A**: Dorsal view; **B**: Ventral view; **C**: Lateral view; **D**: Head in dorsal view; **E**: head in ventral view.

Morphometric measurements were taken according to the scheme by Compagno (1984, 2001) of AtlantNIRO 23074 by the first author and of AtlantNIRO 24000 by the coauthor. The former specimen was digitally radiographed at ZMH, the latter specimen was radiographed at ZIN St. Petersburg on X-ray film and digitalized, and vertebrae and tooth row counts of both were done by the first author. Digital photographs of the former specimen were taken at ZMH, of the latter specimen by the second author.

DESCRIPTION

External morphology description based on the AtlantNIRO 23074 female on loan to Hamburg, which is in good condition except for somewhat squashed snout, upper jaw broken by longline hook and right upper labial furrow damaged. A few differences of the other female n° 24000 are mentioned based on its morphometrics and photographs.

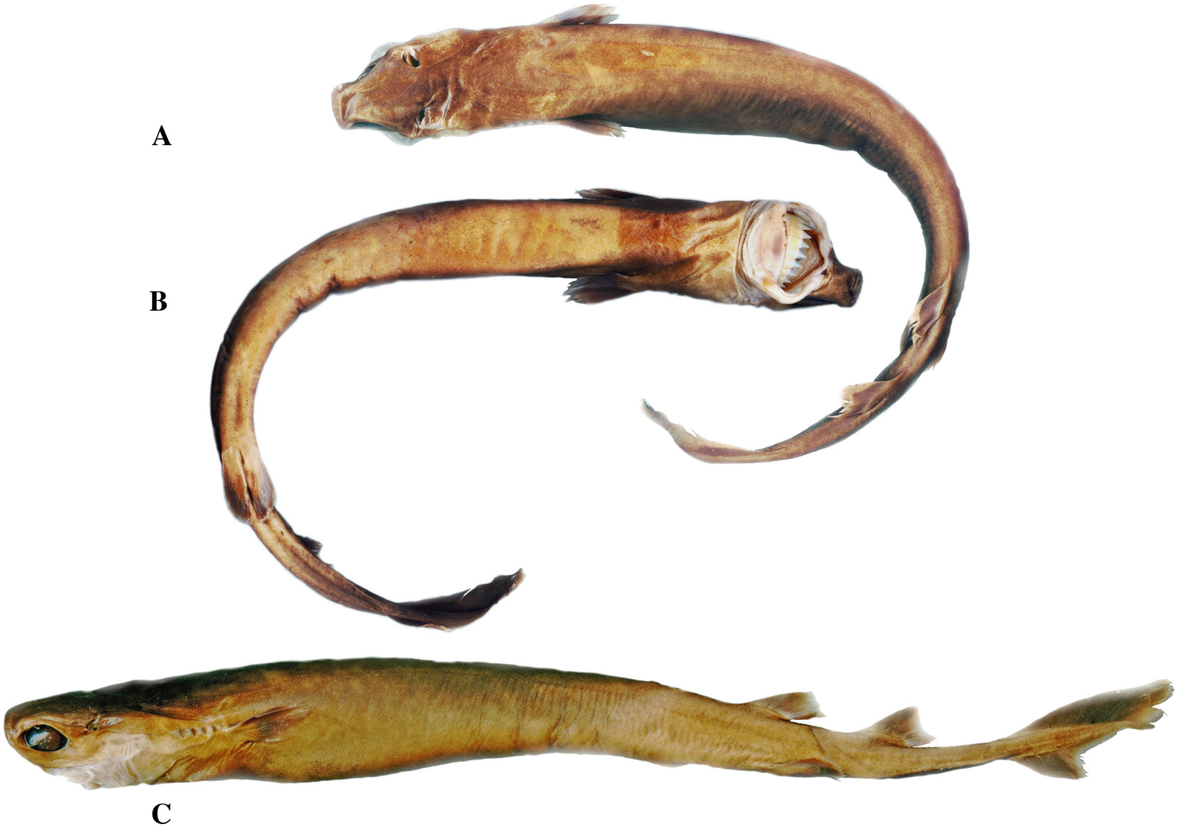

Figure 2. - *Isistius plutodus* female, 330 mm TL, AtlantNIRO 24000, in dorsal (**A**), ventral (**B**) and lateral (**C**) views.

Shape (Figs 1-2)

Body very elongated and slender, cigar-shaped, roundish in cross-section. Upper side of head and anterior half of body length horizontally flat and broad, in posterior half of body rather laterally compressed, with narrowly rounded back and vertically oval shape in cross-section. Head short, five very small gill slits of nearly equal size in straight line level with lower edge of eye; 5th gill slit over pectoral origin. Snout extremely short and narrowly rounded, snout length less than eye length. Cartilaginous interorbital space narrow, smaller than eye length. Eyes almost completely visible in dorsal and frontal view of head, but not so in ventral view. Eyes large, relatively high oval-shaped, with broad skin margin over eyeball. Spiracles large, closely behind eyes dorsolaterally on head, oriented slightly diagonally transverse, much broader than long. Nostrils very small, located at front edge of snout, with small triangular anterior nasal flap. Internarial space narrow, almost equal to cartilaginous interorbital space.

Mouth straight, nearly as broad as head; upper labial furrows huge, about one half of upper jaw length. Right half of upper jaw broken near symphysis, with very tiny and short needle-like teeth in 12+1+12 parallel rows; lower jaw teeth totally different in being tile-like and huge in width and height, and their bases firmly imbricated with each other. Lower teeth vertically rectangular, the broadly triangular cusp about one third of tooth total height and with smooth edges. Cusp in most central lower rows erect, but weakly inclined inwardly in lateral and commissural rows. Total lower jaw tooth rows 19. Naked lips suctorial (Fig. 1E).

Trunk length about four times the head length, with both small, spineless dorsal fins very far rearward. Pectoral fins insert high on upper flanks, small, short-based, ovally paddle-shaped, without free inner margin. Dorsal fins small, 2nd a little larger than 1st, and both dorsal fins rectangularly parallelogram- or flag-shaped; anterior margin rising at 45°, frayed upper margin horizontally weakly rounded, posterior margin straight and parallel to anterior margin, without free inner margin [drawings of dorsal fins, e.g. in Compagno (1984), show both dorsal fins with different shape and with free inner margin]. Short interdorsal space nearly equal to 1st dorsal base length. Origin of 1st dorsal anterior to pelvic origin, which about level with 1st dorsal base end. Space between 2nd dorsal end and upper C-origin nearly equal to 2nd dorsal base length. Pelvic fins short and narrow, their bases end about level of mid-interdorsal space, their posterior tips reaching somewhat beyond 2nd dorsal origin; shape of pelvic fins narrowly elongated rectangular, with outer and inner edges straight, the frayed posterior edge oriented diagonally. Caudal peduncle slender, subquadrate in cross-section, with upper and lower sides flattened, and with distinct lateral keels from level of half 2nd dorsal base to a little beyond lower C-origin and likewise beyond upper C-origin. Caudal fin short and small, with unequally larger upper and much smaller lower lobe; shape like a regular shark caudal fin, not sicle- or half-moon-shaped as in *I. brasiliensis*.

Squamation

Entire body and fins covered with rather loosely-set minute dermal denticles of quadratic to rhombic shape, which are not overlapping with bases or crowns (Fig. 1D, E). Individual placoid scale low, with flat top and a central, circular depression. Frayed edges of fins either smooth, or with more loosely-set dermal denticles. Front

Table I. - Morphometrics of the two new *Isistius plutodus* records from SE Atlantic as percentage of total length. Abbreviations after Compagno (1984, 2001).

AtlantNIRO No.	23074	24000
Total length, mm	420.0	330.0
TOT, total length	100.0	100.0
FOR, fork length	94.0	90.9
PRC, precaudal length	87.1	86.4
PD2, pre-D2-length	73.8	74.2
PD1, pre-D1-length	63.8	65.2
HDL, head length	19.0	19.7
PG1, prebranchial length	14.3	15.8
PSP, prespiracular length	7.4	8.2
POB, preorbital length	2.6	2.7
PP1, prepectoral length	18.2	19.7
PP2, prepelvic length	67.1	66.7
SVL, snout - ant. vent length	69.8	68.2
IDS, interdorsal space	6.2	6.1
DCS, dorsal (D2) - caudal space	7.9	8.5
PPS, pectoral - pelvic space	45.2	43.9
PCA, pelvic - caudal space	15.8	16.7
VCL, ant. vent - caudal tip length	31.4	31.8
PRN, prenarial length	1.1	1.5
POR, preoral length	4.4	4.8
EYL, eye length	4.0	4.5
EYH, eye height	2.1	2.1
ING, intergill length 1st to last slit	3.8	3.0
GS1, 1st gill slit height (unspread)	0.7	0.6
GS2, 2nd gill slit height	0.6	0.6
GS3, 3rd gill slit height	0.6	0.6
GS4, 4th gill slit height	0.5	0.6
GS5, 5th gill slit height	0.5	0.6
P1A, pectoral ant. margin length	7.1	7.9
P1B, pectoral base length	2.4	1.5
P1I, pectoral inner margin length	4.2	3.9
P1P, pectoral post. margin length	4.0	3.9
P1H, pectoral height = base end to tip	6.2	6.1
P1L, P length = ant. base to post. tip	6.9	4.8
CDM, dorsal caudal margin length	14.9	13.6
CPV, preventral caudal margin length	7.1	6.4
CPU, upper postventral C margin length	4.1	6.1
CPL, lower postventral C margin length	2.6	1.8
CFW, caudal fork width	4.6	3.0
CFL, caudal fork length	7.1	6.1
CST, subterminal C margin length	2.1	2.4
CSW, subterminal caudal width	3.2	2.7
CTR, terminal caudal margin length	4.2	4.5
CTL, terminal caudal lobe length	4.8	4.5

AtlantNIRO No.	23074	24000
D1L, D1 total length	–	–
D1A, D1 ant. margin length	7.6	6.1
D1B, D1 base length	4.8	4.2
D1H, D1 vertical height	2.9	2.1
D1UM (D1 upper margin length)	2.1	1.5
D1I, D1 inner margin length	–	–
D1P, D1 post. margin length	3.8	3.0
D2L, D2 total length	–	7.6
D2A, D2 ant. margin length	6.2	6.1
D2B, D2 base length	5.0	4.5
D2H, D2 vertical height	3.3	3.0
D2UM (D2 upper margin length)	2.6	–
D2I, D2 inner margin length	–	3.0
D2P, D2 post. margin length	3.6	3.3
P2L, pelvic total length	7.7	7.6
P2A, pelvic ant. margin length	6.0	4.8
P2B, pelvic base length	3.3	1.5
P2H, pelvic height = max. width	2.1	1.8
P2I, pelvic inner margin length	5.1	3.9
P2P, pelvic post. margin length	2.4	2.4
HDH, head height at P origin	7.5	7.6
TRH, trunk height at P base end	9.5	7.3
ABH, abdomen height at D1 base end	5.4	4.5
TAH, tail height at pelvic base end	4.3	3.3
CPH, caudal peduncle height at C orig.	1.5	1.5
DPI, D1 midpoint - pectoral base end	45.6	43.2
DPO, D1 midpoint - pelvic origin	1.2	0.9
PDI, pelvic midpoint - D1 base end	1.3	0.9
PDO, pelvic midpoint - D2 origin	4.9	4.5
MOL, mouth length (arc radius)	0.0	0.0
MOW, mouth width	8.2	12.1
ULA, upper labial furrow length	4.2	4.2
NOW, nostril width	1.1	1.2
INW, internarial width	1.8	1.5
ANF, ant. nasal flap length	0.4	0.4
INO, interorbital space, skeletal/integumental	1.7/3.3	2.1/3.6
SPL, spiracle length/width	1.4/2.0	1.5/–
ESL, eye - spiracle space	1.2	1.2
HDW, head width at middle gill slits	9.8	7.9
TRW, trunk width at P base ends	8.9	7.9
ABW, abdomen width at D1 base end	3.6	3.1
TAW, tail width at pelvic base ends	2.9	2.4
CPW, C peduncle width at C origin	2.1	2.1

edges of fins with solid rim of a little overlapping dermal denticles, and those along upper caudal margin not saw-like enlarged and imbricated. Dermal denticles on lips smaller, more widely spaced and of more lanceolate shape (Fig. 1E).

Colour

Plain rather dark to medium brown, flanks and belly not markedly lighter, but back of body and head a little darker. All fins brown as body and with semi-transparent and broadly white posterior or upper margins of free ceratotrichia. Eyes blackish-brown, iris golden. Mouth cavity, jaws and gums white; mouth edges pale brown, interior of huge upper labial furrows white. Slightly darker collar indicated on belly and flanks of branchial region.

Differences of the second AtlantNIRO 24000 female: dark collar at branchial region more distinct (Fig. 2B). First dorsal fin rectangularly parallelogram- or flag-shaped as in specimen n° 23074, whereas second dorsal fin shows a pointed apex (hence, no upper margin), a concave posterior margin and a horizontal free inner margin terminating as pointed tip (Fig. 2C). More or less slight differences in some morphometrics, which generally agree well in both specimens, may be due to not exactly equal measuring method by the two coauthors and to ontogenetic reasons because of the difference in size of both specimens.

Meristics

AtlantNIRO 23074: trunk vertebrae 45, of which 38 pre-D1, and 45+5 vertebral centra pre-D2; total tail vertebrae about 50, of which 24 pre-upper C and 25 pre-lower C. Tooth rows upper jaw12+1+12, lower jaw 19.

AtlantNIRO 24000: trunk vertebrae 43, of which about 38 pre-D1 (origin of D1 not clearly visible in X-ray, D2-origin not visible); total tail vertebrae 48+ (terminal ones not well depicted in X-ray), of which about 23 pre-upper C and about 20 pre-lower C. Tooth rows upper jaw 12+1+12, lower jaw 9+1+9.

DISCUSSION

Both atypically flag-shaped dorsal fins in specimen n° 23074 and the likewise flag-shaped first dorsal fin in specimen n° 24000 are not damaged and thus not of artifact shape. Some missing values in table I for dorsal fins are due to their atypical shape, resp., in that in specimen n° 23074 total length, i.e. including free inner margin to its tip, is not given, likewise not for first dorsal fin of specimen n° 24000, but only the base length. Only the flag-shaped dorsal fins of both specimens show an upper margin, but not so second dorsal fin of specimen n° 24000.

Hitherto, the few records of the species display no clear geographical distribution pattern. The majority of all 14 records (including specimens at ZUEC Campinas) was found in the Atlantic, with only the USNM holotype, the lost NW African and the ZMH NE Atlantic records originating from the North Atlantic. Just three specimens have been found in the Western Pacific, and none so far in the Indian Ocean. Most probably is the extreme rarity of accidental catches, as compared with the rather common congener *I. brasiliensis* of worldwide distribution, the reason, why we still know close to nothing of *I. plutodus*. It may well be, however, because both congeners are of no commercial interest for fishermen, that catches of *I. plutodus* have been mistaken for the common *I. brasiliensis*, although the latter grows larger and has "normal" and smaller eyes, smaller and more numerous lower jaw teeth, a longer snout and a larger, rather symmetrical caudal fin. Hence, we can only ask commercial fishermen operating with drift longlines, purse seines or midwater trawls, as well as scientific personnel on board research vessels to keep eyes open and pay attention to catches of *Isistius* sharks for recognising the rare *I. plutodus*, to preserve specimens and forward these to fishery institutes or local museum collections.

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